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## (54) Method for silencing and stabilizing the flame of gas burners fed via pulse width modulation-controlled electromagnetic valves

(57) The method consists of providing a portion (12) of greater cross-section in the gas feed conduit between the electromagnetic valve (2) and the diffuser (6) in a gas appliance, preferably for cooking or heating food.

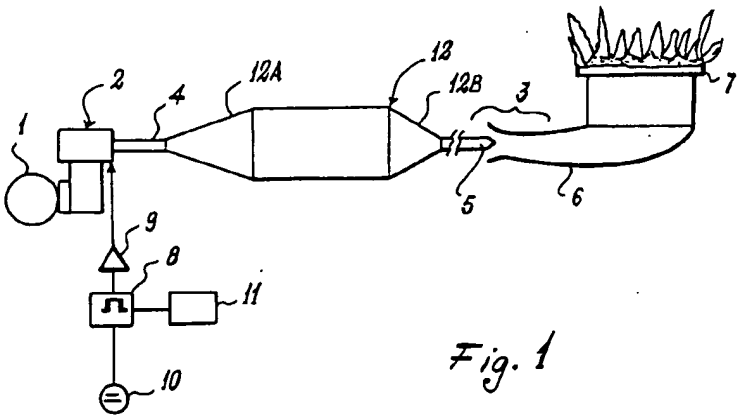


Fig. 1

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## Description

This invention relates to a method for silencing and stabilizing the flame of gas burners fed via pulse width modulation-controlled electromagnetic valves.

The invention also relates to the means for implementing the method.

It is known, for example from EP-A-0550340, to feed a gas burner via a pulse width modulation-controlled electromagnetic valve.

The valve throughput is a function of the duty cycle of the valve opening signal, this (variable) duty cycle being set by the user, for example by acting on a knob or on keys, in relation to the thermal power to be provided by the burner.

In other simpler words the flame is set by the user by fixing the percentage of a predetermined time during which the valve is maintained open. If this percentage is 100%, maximum flame is obtained, the flame being smaller at lower percentages.

At the lowest operating percentages, the consequent throughput fluctuations generate a pulsating flame at the burner with consequent increase in the so-called "flame noise" and in the possibility that the flame becomes unstable and finally extinguished.

The main object of the present invention is therefore to provide a method and means for stabilizing the flame, while at the same time reducing "flame noise".

This and further objects which will be more apparent from the detailed description given hereinafter are attained by the method and means in accordance with the accompanying claims.

The invention will be better understood from the detailed description of a preferred embodiment thereof given hereinafter and illustrated on the accompanying drawing, in which:

Figure 1 is a schematic view of the invention; and
Figures 2 and 3 represent operating graphs.

In the figures the reference numeral 1 indicates the gas feed pipe from any suitable source, which can be the gas distribution mains or a cylinder. To the pipe 1 there is connected a known electromagnetic valve able to alternately interrupt gas passage under the control of variable-width pulses.

The outlet of the valve in question is connected by a conduit 4 to a conventional injector 3 which, as such, comprises a nozzle 5 and a venturi 6. The injector is in fluid communication with a burner 7.

The electromagnetic valve is controlled on the basis of signals emitted by a modulator device 8 and amplified by an amplifier 9.

The modulator device 8 is connected to any direct current source 10 (such as a full wave rectifier provided with filters and connected to the electrical mains supply).

A regulator system 11 comprising an electronic card connected to analog or digital control members is connected to the modulator 8.

These control members can be analog sliders or potentiometers, or digital keys or contacts which enable the user to preset the thermal power emitted by the burner according to his requirements of the moment. Hence said members act on the card to change the state of the system until it corresponds to the required gas throughput. On the basis of this state the modulator device 8 determines the duration of closure/opening of the valve 2 by modulating the signal fed to it.

According to the invention, in order to reduce the "flame noise" in general and the flame pulsations when the burner is at low thermal power, within the conduit 4 there is provided a portion 12 having a cross-section greater than that of said conduit. The portion 12 can for example be formed by modifying the conduit 4 by mechanical operations or by inserting additional components into the conduit and fixing them thereto by welding, by ring nuts or by other known means able to ensure a perfect seal at the points of juncture. The volume enclosed by said portion 12 can, in the case of burners for cooking hobs such as that shown, vary preferably from 15 to 350 $cm^3$ with a ratio of the diameter of its cross-section to that of the conduit 4 of preferably between 3 and 6.

The cross-section through the portion 12 is preferably circular but can be of other shapes and/or positioned closer to the nozzle 5.

Any material allowed by current safety regulations can be used to construct the portion 12 and any components connected to it.

Advantageously, in order to reduce pressure drops and relative turbulent motion to a minimum, both at the inlet and at the outlet of the portion 12, connection pieces 12A and 12B of gradually increasing and respectively decreasing cross-section (for example conical) are provided as shown in Figure 1.

The advantageous results of using the portion 12, which can in fact be considered a silencer/stabilizer, can be seen from Figures 2 and 3, which show the variation in gauge pressured $\Delta P$ against time, the value $\Delta P$ being, in the case of Figure 2, measured at any point of that conduit, without the silencer/stabilizer. which in conventional arrangements connects the electromagnetic valve to the diffuser, whereas in the case of Figure 3 the value $\Delta P$ is measured at the exit of the silencer/stabilizer 12 of adequate dimensions in the arrangement of the invention. The $\Delta P$ measurements are obviously made under the same conditions and hence for equal duty cycles. As can be seen on comparing the graphs, the use of the silencer/stabilizer 12 results in a substantial reduction in pulsations, which can in practice reach annulment.

It should be noted that where the gas enters the portion 12 there is an energy conversion in the sense that part of the kinetic energy of the gaseous stream is converted into pressure energy (piezometric), and vice versa at its exit from said portion.

## Claims

1. A method for silencing and stabilizing the flame of gas burners (7) fed via diffusers (3) and pulse width modulation-controlled electromagnetic valves (2) connected together by a conduit (4), characterised by converting the energy of the gaseous stream between the valve and the diffuser by increasing the cross-section of a portion (12) of the conduit (4).

2. A method as claimed in claim 1, wherein the increase in the cross-section of the portion (12) is followed by a decrease in its cross-section prior to the diffuser (3).

3. A method as claimed in the preceding claims, wherein both the increase and the decrease in the cross-section are gradual (at 12A, 12B) so as to reduce the pressure drop during energy conversion, and the relative turbulent motion.

4. A gas appliance having a burner (7) fed via a diffuser (3) and a pulse width modulation-controlled electromagnetic valve (2), the diffuser and valve being connected together by a gas feed conduit (4), wherein said conduit (4) comprises a portion (12) having a cross-section greater than that of the conduit itself.

5. An appliance as claimed in claim 4, wherein said portion (12) has its ends connected to the conduit (4) in such a manner as to reduce the pressure drop during the passage of the gaseous stream from one to the other.

6. An appliance as claimed in claims 4 and 5, wherein the portion (12) is formed by mechanically modifying the conduit (4) or is an additional component fixed to said conduit.

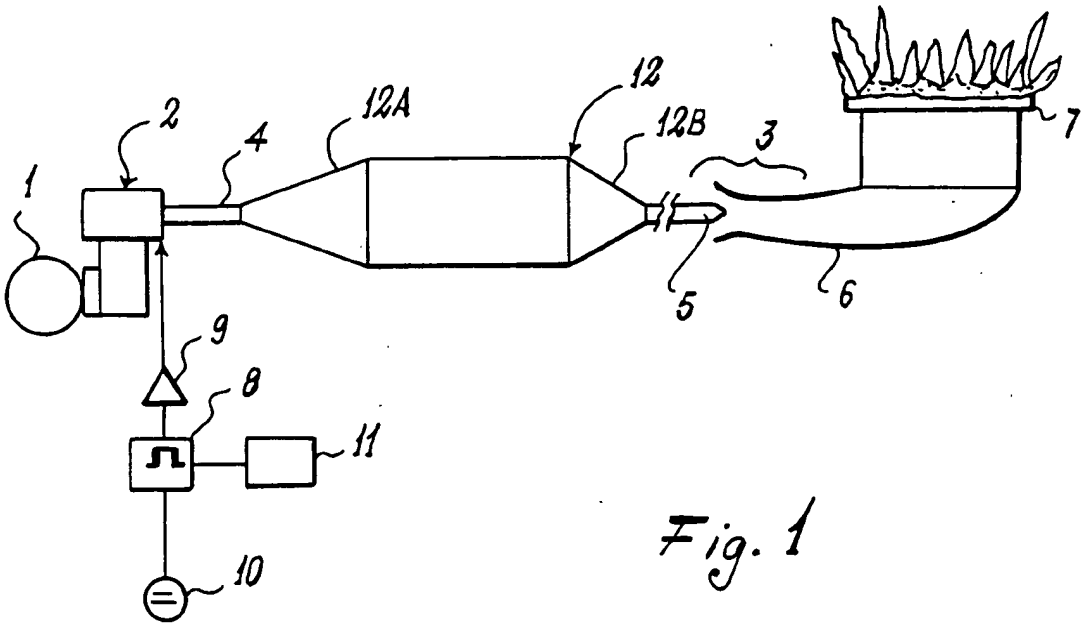


Fig. 1

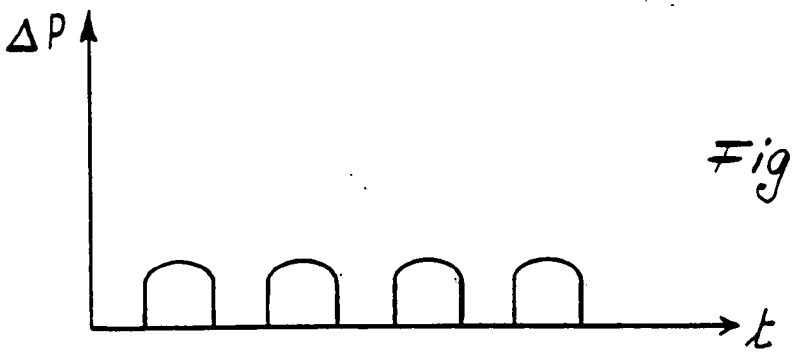


Fig. 2


Fig. 3

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# EUROPEAN SEARCH REPORT

Application Number
EP 97 10 3954

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.6) |
|---|---|---|---|
| X | EP 0 473 451 A (VARIAN AUSTRALIA)<br>* page 3, line 41 - line 46 *<br>--- | 1,4,6 | F23N1/00 |
| A | US 5 234 196 A (HARRIS)<br>* column 8, line 3 - line 40; figures 6,7 *<br>--- | 1,2,4-6 | |
| A | EP 0 532 339 A (PALOMA KOGYO KABUSHIKI)<br>* abstract; figure 1 *<br>----- | 2,5 | |

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F23N

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 13 June 1997 | Kooijman, F |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
L : document cited for other reasons

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